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in

Testik A. (ed.), Baselga M. (ed.).
2. International Conference on Rabbit Production in Hot Climates

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 41

1999
pages 25-30

EFFECT OF WATER TEMPERATURE ON THE FEED AND WATER CONSUMPTION OF FATTENING RABBITS
1. EFFECT OF THE HOT WATER

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SUMMARY - Three trials deal with the comparison of consumption of hot water (about 30°C) and control water (about 20°C). In each trial 36 rabbits are used to compare the consumption of feed and water of 6 cages. In two trials, the air temperature is about 23°C and in one trial, it is about 29°C. The hot water seems to be wasted whatever the air temperature. In fact, the feed/water ratio is higher than 3 against 2 usually. In case of high air temperature, the feed consumption is reduced of 50 % whatever the water temperature. Rabbits don't appreciate hot water but the main factor which explain the reduction of the feed consumption in summer is the air temperature and not the water temperature.

Keys words : Heat, rabbit, water, temperature.

RESUME *- 3 essais de comparaison de consommation d'eau chaude (environ 30°C) par rapport à un témoin à environ 20°C ont été réalisés. Dans chaque essai, 36 lapins ont été utilisés pour comparer la consommation d'eau et d'aliment de 6 cages. Dans 2 essais, la température de l'air est proche de 23°C et dans le troisième, elle est de 29°C. L'eau chaude semble être gaspillée quelle que soit la température de l'air. En effet, le rapport eau/aliment est supérieur à 3 contre une valeur habituelle de 2. En cas de température de l'air élevée, la consommation d'aliment est réduite de 50 % quelle que soit la température de l'eau. Les lapins n'apprécient pas l'eau chaude mais le facteur principal expliquant la réduction de la consommation d'aliment en été est la température de l'air et non celle de l'eau.*

Mots clés *: Chaleur, eau, lapin, température.*

INTRODUCTION

The effect of the heat on rabbits has often been studied. Rabbits do not have sudoriparous gland and then do not support high temperature : if the temperature is higher than 26,7°C, the heat will decrease their metabolism and over 40.6°C their body temperature will increase, leading to their death (Colin, 1985).

The effects of the heat on consumption are the decrease of the feed consumption and the increase of the water consumption (Finzi *et al.*, 1994). Consequently, the fattening performances of rabbit are lower in summer than in winter (Lebas, 1989 ; Ayyat *et al.*, 1996).

This work deals with the behaviour of rabbits in relation with the air temperature and the water temperature. The aim is to determine if water cooling system could improve the performances of rabbits under hot conditions.

MATERIALS AND METHODS

The trials are conducted at the Research and Experimentation Centre of Sanders in Sourches (France) from June to August 1997.

Animals and housing

The Hyplus rabbits are housed in a windowless building with an artificial photoperiod of 8 hours of light and 16 hours of darkness.

The rabbits are weaned at 35 days. They are placed in flat-deck cage of 6 rabbits. The cages are 92 x 51 cm. So, the density is 12.8 rabbits/m². It's possible to put water bottle on these cages at the start of the experimental period.

Diet

During the trials, the rabbits receive the same diet they are fed ad libitum for feed and for water. The analysis of the diet is given in table 1

Table 1. Composition and analysis of the diet (% of the feed)

H2O	11.5
Protein	17.7
Cellulose	14.8

Water

Before the trial, the rabbits receive the tap water of the building. This water is in a tub of 60 L. constantly filled and is brought to the rabbits through pipe and drinker. This is the system usually used in the buildings. In that case, the water temperature is about the temperature of the building.

During the trial, each cage has one or two water bottles of 10 L. On each water bottle, a drinker is placed.

The temperature of hot water to test is 30°C. We use thermoregulated resistance to heat the water.

The control water that we want is about 20°C, which is usually the temperature in the building. In case of higher temperature in the building, we cool the "control water" with ice cubes and isolating plate on each side of the water bottle to maintain it at 20°C.

EXPERIMENTAL DESIGN

There are three different trials with two experimental designs.

Free choice design (Trial 2)

Each cage is equipped with two bottles of water, a control one and a hot one. 2 days before the beginning of the trial, 3 cages receive only the control water and 3 cages receive only the hot water to prevent from the effect of the water temperature before the trial on the choice of the rabbits.

Each day, the bottles are removed and their position are reversed to prevent from the habit of drinking in one point. The trial lasts 5 days.

The rabbits are 56 days of age and weigh 1700 g at the beginning of the trial. There are 6 cages of rabbits.

Qualitative design (Trial 1 and 3)

Each cage is equipped with only one bottle of water: the control water or the hot water.
The trial lasts 5 days.
In trial 1, the rabbits are 49 days of age and weigh 1420 g at the beginning of the trial.
In trial 3, the rabbits were 49 days of age and weigh 1660 g at the beginning of the trial. There are 10 cages of 6 rabbits.

RECORDINGS

The temperatures are recorded three times per day at 8:00 am, 2:00 pm and 6:00 pm. The water temperature in the bottle and at the exit of the drinker and the air temperature are noticed.

Water consumption is recorded at 8:00 am and 6:00 pm. Feed consumption is recorded at 6:00 pm

STATISTICAL ANALYSIS

The statistical analysis of treatment effect for free choice trial is the student test.
In case of qualitative trial, the number of cages allows to have information about the behaviour of rabbits.

RESULTS AND DISCUSSION

Trial 1

Table 2 gives the water temperature and the air temperature of the trial.

Table 2 : Temperatures of air and water at different hours of the day (°C)

		8:00 am	2:00 pm	6:00 pm
AIR		19.0 ± 0.7	20.4 ± 1.1	21.1 ± 0.8
CONTROL WATER	Water bottle	17.8 ± 0.4	18.3 ± 0.4	18.4 ± 0.4
	Drinker	17.8 ± 0.4	18.0 ± 0.7	19.2 ± 0.7
WATER 30°c	Water bottle	32.0 ± 4.5	33.9 ± 1.8	34.2 ± 2.0
	Drinker	27.6 ± 3.4	28.8 ± 1.6	30.8 ± 1.1

The water temperatures are in accordance with the goal of the water. The air temperature is the same than the control water.

Table 3 gives the results of consumption.

Table 3 : Consumption of feed and water by cage (g/day/rabbit)

Treatment	Control water	Water 30°C
Number of rabbits	18	18
Number of cages	3	3
Feed intake	141.6 ± 35.0	121.2 ± 15.5
Water intake	263.3 ± 21.8	285.0 ± 21.3
Water/Feed	1.97 ± 0.67	2.33 ± 0.10

The water consumption of hot water is very high (285.0 g/rabbit/day) in relation with the age of the rabbits and the feed consumption. The water/feed ratio is 2.33, which is high. The water/feed ratio for control water is only 1.97. With hot water, feed consumption is slightly but not significantly lower.

With an air temperature around 20°C, it seems that rabbits waste the hot water.

Trial 2

Table 4 gives water and air temperature during the trial.

Table 4. Temperatures of air and water at different hours of the day (°C)

		8:00 am	2:00 p.m.	6:00 p.m.
AIR		20.4 ± 1.7	23.4 ± 2.1	23.8 ± 2.6
CONTROL WATER	Water bottle	19.5 ± 1.6	20.3 ± 1.0	21.3 ± 1.3
	Drinker	19.7 ± 2.1	21.0 ± 1.4	21.7 ± 1.5
WATER 30°c	Water bottle	33.1 ± 1.1	33.9 ± 1.0	33.8 ± 1.3
	Drinker	28.0 ± 2.5	29.6 ± 2.0	29.9 ± 2.2

The temperatures are in accordance with the goal of the trial.

Table 5 gives the results of consumption.

Table 5. Consumption of water (g/day/rabbit/water-bottle)

		Control water	Water 30°C	Total
Number of rabbits		36		
Number of cages		6		
	Day 1	147.2	200.3	347.5
	Day 2	86.7	211.2	297.9
Water intake	Day 3	160.8	166.2	327.0
	Day 4	66.7	261.0	327.7
				324.3
Water intake	Day 1-4	114.6	209.7	
Water intake (% water/bottle)	Day 1-4	36	64	

The Student Test is significative at 1 % for the comparison between hot and control water : rabbits drink significantly more hot water than control water in case of air temperature of 20 to 23.8°C. Hot water is always more consumed than control water.

The consumption of water is 324.3 ± 59.7 g/rabbit/day and the consumption of feed is 127.4 g/rabbit/day. So, the water/feed ratio is 2.5 ± 0.5. The water consumption and the water/feed ratio are quite high for rabbits of 49 days of age and for an air temperature of 20°C.

The hot water consumption is perhaps higher because it is wasted : for the treatment water 30°C, 4 values are corrected because they are aberrant (too high).

The consumption is very irregular in relation with the day. It could be in relation with the daily inversion of the water-bottle. This could presume that some rabbits are always drinking at the same place, whatever the water temperature.

Trial 3

Table 6 gives water and air temperature during the trial.

Table 6 : Temperatures of air and water at different hours of the day (°C)

		8:00 am	2:00 pm	6:00 pm
AIR		22.5 ± 1.0	27.5 ± 1.7	29.2 ± 1.6
CONTROL WATER	Water bottle	21.0 ± 1.0	20.0 ± 1.3	19.5 ± 1.4
	Drinker	21.4 ± 0.9	21.8 ± 1.4	20.4 ± 1.0
WATER 30°c	Water bottle	34.2 ± 1.4	34.5 ± 1.0	34.6 ± 0.9
	Drinker	30.7 ± 2.0	31.6 ± 1.4	32.3 ± 1.3

The water temperatures are in accordance with the goal of the trial. The air temperature is around 27.5°C. It is summer conditions in France.

Table 7 gives the results of consumption.

Table 7. Consumption of feed and water by cage (g/day/rabbit)

Treatment	Control water	Water 30°C
Number of rabbits	30	30
Number of cages	5	5
Feed intake	81.3 ± 6.9	77.1 ± 9.5
Water intake	189.7 ± 29.9	233.6 ±44.2
Water/feed	2.33 ± 0.28	3.01 ± 0.25

In case of high temperature in the building, the feed consumption is reduced whatever the water temperature (80 g vs 140 g for trial 1). In that case, water consumption is still higher with hot water than with control water but the water/feed ratio is higher than 2 (which is the usual value of this ratio) for both treatment. It is 3.01 for the hot water and 2.33 for the control one so, the hot water could have been more wasted than the control water.

In those three trials, hot water intakes are higher than control water intakes, whatever the design or the air temperature. This is in accordance with Rafai *and al.*, (1984), Jin *and al.*, (1990), Marai *and al.*, (1996) who showed that water intake increases in summer conditions (higher temperature of the water). Moreover, water intake is reduced in summer with cool water in comparison with hot water (Marai *and al.*, 1996).

In case of summer conditions (Trial 3), the feed intake is reduced in comparison with air temperature of 20°C (trial 1), whatever the temperature of the water.

The reduction of feed in summer conditions is always observed (Jin *and al.*, 1990 ; Rafai *and al.*, 1984 ; Marai *and al.*, 1996, Chiericato *and al.*, 1994, Finzi *and al.*, 1994) but the water temperature is usually equivalent to the air temperature.

Duperray *and al.*, (1998) have differences between water and building temperature. They show a reduction of the feed intake in case of high air temperature against control air temperature (17 to 19°C), which is in accordance with our trial but they show too an increase of feed intake for does and fattening rabbits in case of water at 18 to 19°C against 30 to 32°C with air temperature of 30 to 32°C. Nevertheless, in our trial we have equivalent feed intake whatever the temperature of water in case of summer conditions. In fact, our trial lasts only a few days and there is perhaps a difference of feed intake when measuring a few weeks. The increase of feed intake with cool water could be due to a diminution of the body temperature by internal cooling, which could increase the appetite of the animals (Marai *and al.*, 1996).

All those results show that it is more interesting in rabbitries to cool the air than to cool only the water because there is a higher influence of air temperature than water temperature on the feed intake of rabbits and, moreover, cooling the buildings will cool the water. Nevertheless, if it is not possible to cool the building, cooling the water can slightly improve the results (less water wastage and tendency to increase feed intake).

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